DOCUMENT RESUME

ED 078 095 TM 002 915

AUTHOR Winne, Philip H.; And Others
TITLE Acquisition and Retention as a Function of Three Types of Repetition.
NOTE 16p.; Presented at Annual Meeting of American Educational Research Association (New Orleans, Louisiana, February 25-March 1, 1973)

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS Associative Learning; Cognitive Processes; *College Students; Hypothesis Testing; *Learning Processes; *Retention; Teaching Techniques; Technical Reports; *Word Lists; Word Recognition

ABSTRACT

Seventy-two university students were exposed to one of four repetition treatments for one of three different amounts of information presented in a chunked format. Implicit chunk repetition, i.e., the presentation of words not present in the original word list but logically belonging to a previously seen chunk, facilitated acquisition and retention of information relative to explicit chunk repetition (p.01 and p.05, respectively), explicit item repetition (p.05 and in both instances), and a no repetition condition (p.01 and p.10, respectively). No repetition was found to be most efficient, while implicit repetition combined effectiveness with efficiency relative to traditional techniques of repetition. An association-restructuring hypothesis was proposed as the functioning cognitive mechanism for enhancement of learning under repetition. (Author)

FILMED FROM BEST AVAILABLE COPY

ED 078095

U S DEPARTMENT OF HEALTH
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

ACQUISITION AND RETENTION AS A FUNCTION OF THREE TYPES OF REPETITION

Philip H. Winne, William E. Hauck, J. William Moore

Bucknell University

TM 002 915

Abstract

Seventy-two university students were exposed to one of four repetition treatments for one of three different amounts of information presented in a chunked format. Implicit chunk repetition, i.e., the presentation of words not present in the original word list but logically belonging to a previously seen chunk, facilitated acquisition and retention of information relative to explicit chunk repetition ($p<.01$ and $p<.05$, respectively), explicit item repetition ($p<.05$ in both instances), and a no repetition condition ($p<.01$ and $p<.10$, respectively). No repetition was found to be most efficient, while implicit repetition combined effectiveness with efficiency relative to traditional techniques of repetition. An association-restructuring hypothesis was proposed as the functioning cognitive mechanism for enhancement of learning under repetition.

ACQUISITION AND RETENTION AS A FUNCTION OF THREE TYPES OF REPETITION

Philip H. Winne, William E. Hauck, J. William Moore

Bucknell University

It seems reasonable to assume that optimal instructional processes should use methods of communication which both increase the quantity of information learned, thus maximizing the effectiveness of communication, and decrease the time needed to learn a specified amount of information, i.e., maximize the efficiency of effective communication. The grouping of related items into larger units or categories has already proven its worth in increasing the effectiveness of communication (e.g., Mandler, 1967). Repetition is another common technique that has been shown to improve the effectiveness of communication e.g., Waugh (1963). Surprisingly, no research has examined the efficiency of repetitive procedures; yet, findings regarding the relative effectiveness and efficiency of various types of repetition would appear essential to designing optimal instructional processes in that the total time allotted for the presentation of new information is necessarily decreased when previously presented information is repeated. Thus, the purpose of the present study was to investigate the relative effectiveness and efficiency of learning by various methods of repeating information when the total body of information is presented in a categorized structure.

Much past research on human learning has examined techniques intended to to improve the effectiveness of communicating information. Specifically, emphasis has been placed on maximizing the probability that a learner will acquire

and retain information presented to him. For example, a number of studies (Dallett, 1964; Cofer, et al., 1966) indicate that the recall of information is significantly improved when individual units of information are grouped together or chunked (Miller, 1956) according to a meaningful scheme. The result is expected in view of the fact that, if no obvious structure of information is inherent in the presented information, learners frequently self-impose an organization on material (Bousfield, 1953) and, thereby reduce the total time spent on storing the information (Frase, 1969). Necessarily, the amount of recalled information is less than the amount that could be recalled had the learner been able to spend all of the time allotted for presentation or acquiring the information as opposed to structuring and acquiring the material.

Other investigators (Tulving, 1962; Mandler, 1968; Bower, 1969; Johnson, 1970) found that the recall of information can be measured in terms of "chunk units" rather than the number of individual items of information to be recalled. Further support for the chunk recall hypothesis, i.e., the proposition that informational items are recalled by first recalling a chunk containing the items and then decoding the chunk to recall the specific items, is found in a study by Tulving and Pearlstone (1966). They showed that making the chunk accessible during the recall trial by supplying S with the chunk label as a cue for the retrieval of the chunk and its items significantly improved the total amount of information recalled. A later study (Tulving and Osler, 1968) in which cues were present during the acquisition period, the recall trial, or both for each of 24 words to be recalled, somewhat contradicted the results of the Tulving and Pearlstone (1966) study. However, these findings can be considered an invalid test of the chunk recall hypothesis for several reasons. First, each of the 24 to be remembered words on the study list was cued by a weak associate. Under all treatment conditions, it would be expected that such cues would evoke responses

more highly associated with the cue than the word on the study list. Second, if each of the 24 words on the study list was relatively unassociated with any other word on the list, then each word or word-cue pair can be considered a chunk of information. Thus, one would not expect high recall under any of the treatments as 24 chunks certainly exceeds the span of immediate memory. A probable cause for the inflation of the recall is that these conditions transform the relatively more difficult free recall task into a paired-associate task, thereby exaggerating the positive effects of this treatment. Thus, the Tulving and Osler (1968) study can not be considered a valid test of the chunk recall hypothesis.

One method of increasing the probability that a chunk and its items will be acquired and retained is to repeat information during the period in which it is presented, e.g., Miller (1958). Waugh (1963) examined the effects of repeating specific words within a word list as a function of the number of intervening items between the word's first occurrence and its repetition. She found the probability of recall of a repeated word to be approximately twice that of a word presented only once. If the assumption is made that each word is relatively unrelated to any other word in the total list, i.e., that each word may be considered a chunk with one item, then the probability of the recall of a chunk is directly proportional to the number of times the chunk is encountered during the acquisition phase of learning.

From the findings of past research, it can be concluded that the recall of items of information is dependent on the acquisition, retention, and retrieval of chunks containing those items. In the present study, it was hypothesized that techniques of repetition which reconceptualize a chunk of information are more effective and efficient methods of communication than those in which individual items of information are repeated.

Method

Sample

The Ss were 72 volunteer college students. Each S was randomly assigned to one of 12 different groups in a replicated design.

Treatment and Design

Each S viewed a chunked format word list characterized by one of three levels of a number of chunks factor (C) and one of four types of repetition. The number of chunks factor had values of 3, 5, and 7. The four types of repetition were no repetition (NR), explicit chunk label repetition (ECR), implicit chunk repetition (ICR), and explicit item repetition (EIR). The experiment was replicated yielding a 3 X 4 X 2 factorial design.

Materials and Methods

Each word list was presented in chunked format and was composed of the appropriate number of chunks for each treatment. Each chunk consisted of the chunk label in underlined capital letters followed by five words that logically belong in that chunk. The chunk labels and words belonging in the chunks were drawn from the revised Connecticut category norms (Battig and Montague, 1969). The chunk labels were randomly selected. To control for highly probable or unusual association effects, the words within each chunk were randomly selected from the sixth to the twentieth most frequent associations to each chunk label. In the original word list, all chunks were randomly arranged. The words within each chunk were also randomly ordered. Under the ECR, ICR, and EIR treatment conditions, the repetitive word groups were randomly arranged in a separate section of the word list which immediately followed the original word list.

In the NR treatment group, no words were repeated from the original word list. Under the ECR treatment condition, each chunk label, e.g., furniture, was repeated

in the repetitive section of the word list. The ICR treatment condition was effected by presenting two new words per previously seen chunk grouped according to their membership in a chunk. For example, if the chunk "furniture" had originally presented chair, stool, bed, lamp, and table as within-chunk items, the introduction of the words sofa and desk in the repetitive section of the word list would constitute the ICR treatment. Under the EIR treatment, two words already presented in a previously seen chunk were repeated, also grouped according to their membership in a chunk. In terms of the example, the words bed and chair might be repeated.

All instructions and materials were presented via video tape recording. E verbally answered any questions that arose after the taped presentation of instructions. Each word was presented for three seconds and a three second blank space separated the last word of a chunk from the next word on the list.

After the presentation of the word list, Ss were verbally instructed to write all the words which could be recalled from the word list. The score on this recalled list of words constituted the acquisition measure (AM). After 24 hours, Ss were recalled and instructed to write all the words they remembered from the word list they had seen the previous day. The score on this list of recalled words constituted the retention measure (RM).

Scoring System

A unique scoring system was developed for measuring the extent to which a chunk of information was recalled. Previous investigations, e.g., Cohen (1966), used a binary scoring system in which a chunk was considered to be forgotten if none of the items within the chunk were recalled; on the other hand, a chunk was considered to be recalled if one or more of its items was recalled. However, no measure was

used to determine the degree to which an entire chunk of information was recalled.

The scoring system adopted in this study was as follows. The recall of a chunk label received a score of zero in that there was no evidence that the information within the chunk, i.e., the words to be learned, could be recalled. The recall of each word that appeared in the word list as a within-chunk item was scored +2. Chunk intrusions, i.e., words recalled that did not appear in the presented word list but that were considered by independent judges to logically belong to a presented chunk received a score of +1. The rationale for this score is that the verbatim recall of information learned in the classroom is occasionally unnecessary, and it is often the case that generalization within a chunk of presented information is desirable. In addition, the recall of chunk intrusions is indicative of the recall of the chunk containing the intrusion according to the chunk recall hypothesis. The sum of the scores for the words recalled served as the scores for AM and RM.

Two 3 X 4 X 2 analyses of variance in which repetition condition, number of chunks, and replication were the independent variables, respectively, were used to test the hypotheses of this study with respect to two dependent variables: (a) scores on AM; and (b) scores on RM.

Following both analyses of variance, Neuman-Keuls Posttests were used to determine significant differences between pairs of appropriate means.

Results

Means on AM for Groups ICR, NR, ECR, and EIR were 45.61, 36.55, 36.44, and 36.39, respectively ($F = 4.76$, $df = 3/48$, $p < .01$). Means on AM for Groups 3C, 5C, and 7C were 25.33, 39.38, and 51.34 respectively ($F = 52.14$, $df = 2/48$, $p < .001$). Newman-Keuls posttests for appropriate pairs of means indicated that the ICR group differed significantly from the NR and ECR groups ($p < .01$ in both cases)

in the amount of information acquired, and that the ICR group was also significantly different from the EIR group ($p<.05$) on the same measure. The ordering of repetition treatment group means on AM is ICR<NR<ECR<EIR (see also Figure 1).

- - - - - - - - - - - - - - -

Insert Figure 1 about here

- - - - - - - - - - - - - - -

Regarding the number of categories treatment condition, Newman-Keuls posttests showed the 7C group to be significantly different from both the 5C and 3C groups ($p<001$ in both instances) on the amount of information acquired, and the 5C group to be significantly different from the 3C group ($p<.001$) on the same variable. The ordering of number categories treatment group means on AM is 7C>5C>3C.

On RM measurements, means for Groups ICR, NR, ECR, and EIR were 41.00, 32.89, 32.95, and 31.28, respectively ($F = 2.99$, $df = 3/48$, $p<.05$). The means for Groups 3C, 5C, and 7C on RM were 24.38, 25.00, and 44.21, respectively ($F = 20.46$, $df = 2/48$, $p<.001$). Analysis of the repetition group means on the RM measure using Newman-Keuls posttests revealed that the ICR treatment group was significantly different on the amount of information retained from the ECR and EIR groups ($p<.05$ in both cases), and that the ICR treatment group was also significantly different from the NR group ($p<.10$). The ordering of repetition treatment group means on RM is ICR>ECR>NR>EIR (see also Figure 1).

With respect to the number of categories treatment, Newman-Keuls posttests revealed that the 7C group was significantly different from both the 5C group ($p<.01$) and the 3C group ($p<.001$) on the amount of information retained, and that the 5C group differed significantly from the 3C group ($p<.01$) on the same measure. The ordering of the number of categories treatment group means on RM scores is 7C>5C>3C.

Discussion

The results obtained in this investigation are surprising and significant in a number of respects. First, both intuition and past experimentation, e.g., Waugh (1963), assert that the acquisition of information is improved when individual items of information are repeated during the study trial. However, in the present study, no facilitative effects were obtained by repeating within-chunk items in terms of the proportion of total information acquired by Ss even when the EIR group was compared to the control (NR) group. In addition to being the least effective of the repetition treatment conditions, the explicit repetition of within-chunk items was also the least efficient of the repetition treatments as indicated by an efficiency index calculated by dividing the score on the recall measure by the total time for presentation of the word list.

As would be expected, there was a greater degree of learning for the specific items repeated relative to those which were not repeated. This result implies the intuitive conclusion that the repetition of individual units of information is effective in improving only the probability that the repeated items will be acquired by a learner. Under this mode of repetition, it may be concluded further that the probability that a given quantity of information will be acquired is directly proportional to the number of items of information which are repeated. While such a procedure may maximize the effectiveness of communication with regard to the quantity of informational elements acquired, it certainly is a poor communicative technique in terms of efficiency.

A second conclusion of this study pertains to the repetition of chunk labels during the study trial. Based on the chunk-recall hypothesis, e.g., Bower (1969), it was predicted that repeating the chunk label, as in the ECR treatment condition, would enhance the learning of information presented in a chunked format by providing S with a review of the conception which the chunk was formed. The prediction

was not supported by the data. Specifically, the repetition of the chunk label increased the probability that the chunk label would be learned, but it did not significantly increase the learning of the total amount of presented information. Also, although the ECR treatment condition was more efficient than the EIR treatment, it was no more effective. Nor was the ECR treatment more effective than the NR treatment while it was also less efficient than the NR treatment condition. Thus, in comparing the explicit repetition of information, either in the form of within-chunk items or chunk labels, to the presentation of the information involving no repetition, it may be concluded that no benefits to learning the total amount of information presented are obtained by repeating information to be learned. This conclusion is definitely in contradiction to the findings of previous experimentation. However, a tentative explanation for this effect is offered in the following discussion of the ICR treatment results.

With regard to findings pertaining to the ICR treatment condition, three conclusions merit discussion. First, although the percentage of actual recall relative to perfect recall on AM was slightly less than that for the other repetition treatment groups, the ICR treatment condition was the most effective technique of repetition with respect to maximizing both the number of items recalled per chunk and the total amount of information recalled. This finding points to the feasibility of a form of repetition for improving the probability that information will be learned.

A second conclusion pertaining to the implicit repetition of a chunk of information calls for considerable reflection. The fact that the introduction of additional information, i.e., the presentation of two new within-chunk items per chunk, resulted in a greater degree of learning suggests several implications. First, it seems reasonable to assume that a chunk of information can be cued during the study trial in such a fashion as to effect repetition of the complete

chunk. It is postulated that the increase in learning under implicit chunk repetition is brought about by inducing S to actively restructure the cognitive associations for the already acquired chunk of information in order to store the two newly presented within-chunk items. In accomplishing this restructuring of existing associative coding systems, it is speculated that not only is the chunk "concept" reviewed by its being retrieved from storage, but that the items within the chunk are also reviewed when S codes and stores the newly presented chunk items along with those items already acquired. That learning was not facilitated by the explicit repetition of previously seen chunk labels or within-chunk items can be explained easily by the postulated chunk restructuring hypothesis. Under the ECR treatment condition, the repetition of a chunk label that has been previously presented does not demand a restructuring of information already stored in an associational network. Therefore, there is no facilitative effect due to this mode of repetition. In the EIR treatment group, the repetition of previously presented within-chunk items does not induce Ss to restructure associations for acquired informational items. Therefore, it, too, does not improve learning. A second hypothesis that attempts to reconcile the facilitating effects of explicit repetition found in previous research with the non-facilitative effect produced in this study also supports the notion of associational restructuring as the significant aspect in repetition. In the present study, the information to be learned was presented to S in a chunked format which placed restrictions on the variability of the associational codes usable for storing the information. The explicit modes of repetition used herein were not conducive to a restructuring of the stored information within the range of associational codes permissible by the nature of the input. However, in prior investigations of the effects of repetition, frequently the information has been presented to S in an unstructured format. In fact, caution was usually taken that no informational items to be learned were related

to other informational items so as to control for the effect of recall of non-repeated items by their association to repeated items. Thus, it is hypothesized that the facilitating effects of implicit and explicit modes of repetition are moderated by the structure of the informational input which is, in turn, a major determinant to the type of facilitative restructuring available to S as a result of various types of repetition to which he is exposed.

The third conclusion regarding the results obtained under the ICR treatment condition have significant implications for the realities of classroom instructional processes. First, the ICR treatment was the most effective of the modes of repetition examined in terms of the quantity of information learned. Second, and of particular importance, the ICR treatment was 23% more effective than the traditional repetition technique as exemplified by the EIR treatment while requiring the same amount of time for presentation of the information. Thus, it combines both desired qualities of efficiency and effectiveness. It is predicted that the use of implicit repetition techniques in the classroom will both improve the quantity of information learned by students and increase the amount of time that can profitably be spent on presenting new information vs. repeating information.

A final conclusion of this study, supporting much past research, e.g., Mandler (1967), Bower (1969), is that the recall of information can be expressed in terms of the number of chunks of information to be recalled. In terms of the scoring system adopted for this study, AM scores can be predicted as a linear function of the number of chunks, $Y = 6.55X + 5.78$, and RM scores can be predicted with $Y = 4.96X + 9.85$. Thus, the findings of this study quantitatively support the chunk recall hypothesis (Tulving, 1962).

It is believed that the present study suggests at least three directions for further research. First, the notion of a repetitive technique which is of an implicit nature is new to research in verbal learning. The fact that it can

improve learning beyond that obtained with other types of repetitive methods is, in itself, an impetus to further describe how and why these effects are produced. Thus, research intended to describe the attributes and mode of functioning of implicit repetitive methods is needed. Second, although there were no statistically significant differences between the no repetition group and the explicit repetition groups, the existing differences, slightly in favor of the NR groups, suggest an interesting conjecture. In keeping with the notion that the structure of information to be learned may be a determinant of how a particular mode of repetition affects learning, it is speculated that an explicit form of repetition coupled with a well-defined structure of presented information may be conducive to initiating retroactive interference effects. It is possible that interference effects arise because of the absence of an associational restructuring process which is capable of removing ambiguity in the already stored information. A third avenue of experimentation is that of investigating the effects of implicit repetition on the learning of more meaningful information such as frames in a programmed learning sequence or prose passages. Such an extension of the present study could provide a direct link between basic research in verbal learning and practical application of the findings of this research to the design and implementation of classroom instructional processes.

References

Battig, W. F. & Montague, W. E. Category norms for verbal items in 56 categories: A replication and extension of the Connecticut category norms. Journal of Experimental Psychology Monograph, 1969, 80 (3), pt. 2.

Bousfield, W. A. The occurrence of clustering in the recall of randomly arranged associates. Journal of General Psychology, 1953, 49, 229-240.

Bower, G. H. Chunks as interference units in free recall. Journal of Verbal Learning and Verbal Behavior, 1969, 8, 610-613.

Cofer, C. N., Bruce, D. R. & Reicher, G. M. Clustering in free recall as a function of certain methodological variations. Journal of Experimental Psychology, 1966, 71, 858-866.

Dallett, K. M. Number of categories and category information in free recall. Journal of Experimental Psychology, 1964, 68, 1-12.

Frase, L. T. Paragraph organization of written materials: The influence of conceptual clustering upon the level and organization of recall. Journal of Educational Psychology, 1969, 60, 394-401.

Johnson, N. F. The role of chunking and organization in the process of recall. In The Psychology of Learning and Motivation, Vol. 4. G. H. Bower (Ed.), New York: Academic Press, Inc., 1970, pp. 171-247.

Mandler, G. Organization and Memory. In The Psychology of Learning and Motivation, Vol. 1. K. W. Spence & J. T. Spence (Eds.), New York: Academic Press, Inc. 1967, pp. 328-372.

Mandler, G. Organized recall: Individual functions. Psychonomic Science, 1968, 13, 235-236.

Miller, G. A. The magical number seven, plus or minus two: Some limits on on our capacity for processing information. Psychological Review, 1956, 53, 81-97.

Miller, G. A. Free recall of redundant letter strings. Journal of Experimental Psychology, 1958, 56, 485-491.

Tulving, E. Subjective organization in free recall of unrelated words. Psychological Review, 1962, 69, 344-354.

Tulving, E. & Pearlstone, Z. Availability versus accessibility of information in memory for words. Journal of Verbal Learning and Verbal Behavior, 1966, 5, 381-391.

Tulving, E. & Osler, S. Effectiveness of retrieval cues in memory for words. Journal of Experimental Psychology, 1968, 77, 593-601.

Waugh, N. C. Immediate memory as a function of repetition. Journal of Verbal Learning and Verbal Behavior, 1963, 2, 107-112.

Figure 1

Repetition Groups: AM and RM Scores